

FNAL beam test update

2015-02-09

Aiwu Zhang

Florida Tech

“error estimation” method:

To study one detector,

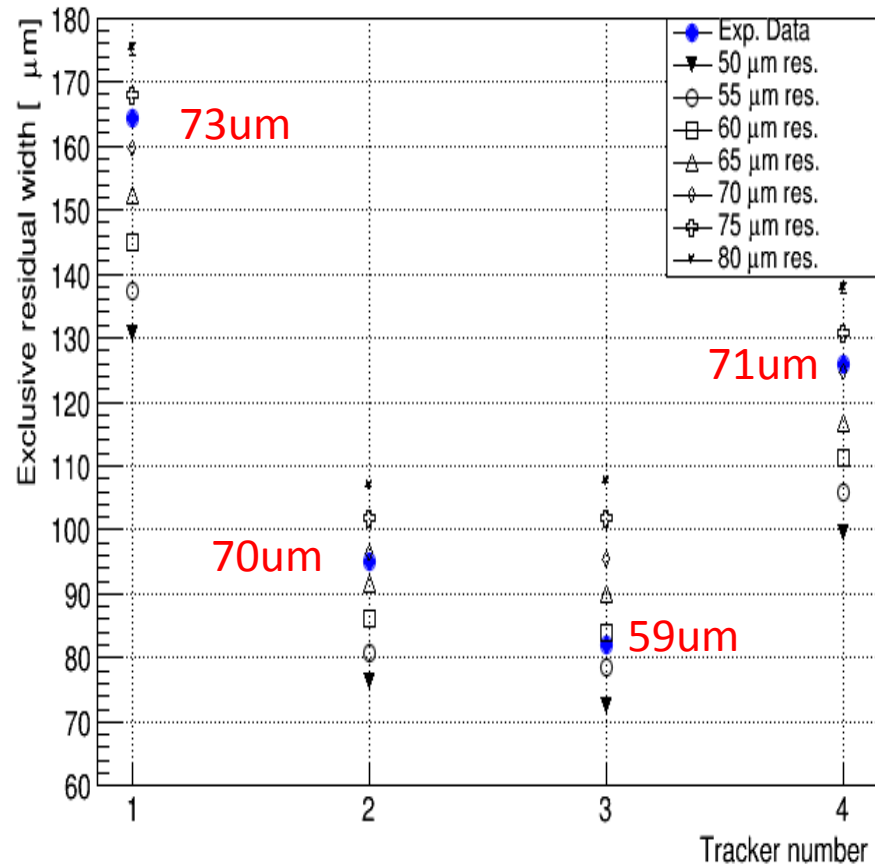
1. Smear other detectors with right resolutions (close to true resolutions). The exclusive residual width is then considered as track error (EE), with the multiple coulomb scattering effect convoluted.
2. From the exp. Data, exclusive residual width (ER) can be get. Then the detector's resolution is taken as $\sqrt{ER^2 - EE^2}$.

To study a tracker, will only use other three trackers to build tracks (to get EEs). Assume all four trackers have same resolution, smear trackers from 40um to 95um with a step of 5um, compare the ERs with exp. Data. In such a way trackers' resolutions can be found.

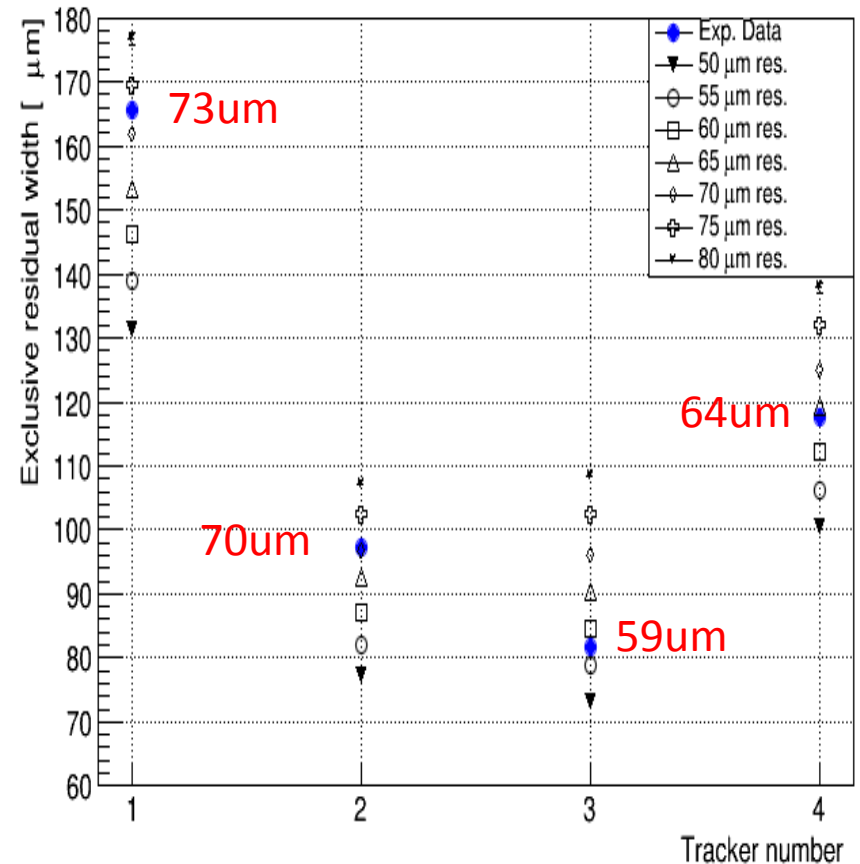
Once trackers' resolutions are known, smear them and to calculate EE for the FIT EIC zigzag chamber. Its ER is known so that its resolution can be calculated.

Trackers' resolutions

X coordinate

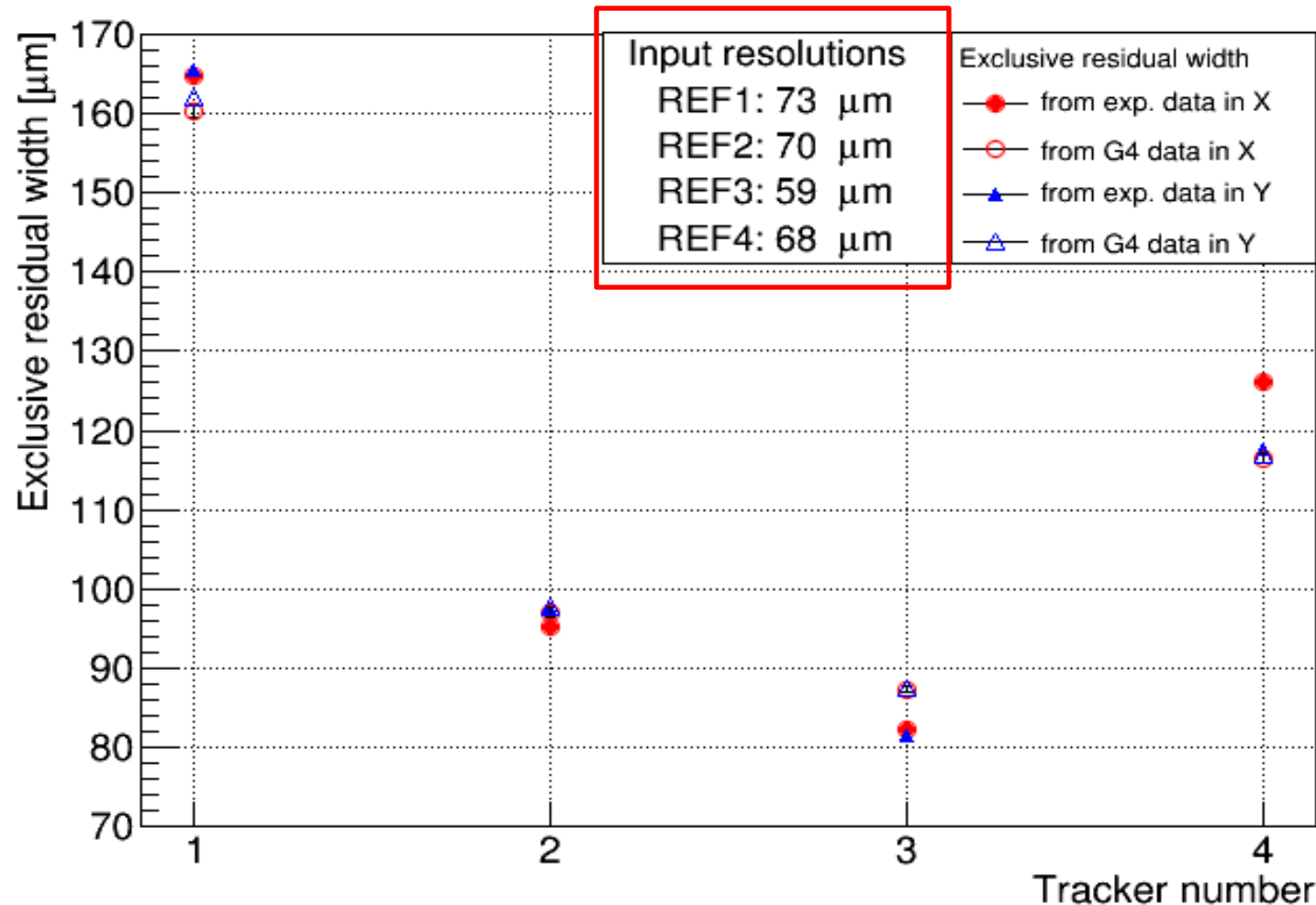


Y coordinate



- 32GeV/c simulation data.
- Blue points are ERs of trackers from exp data.

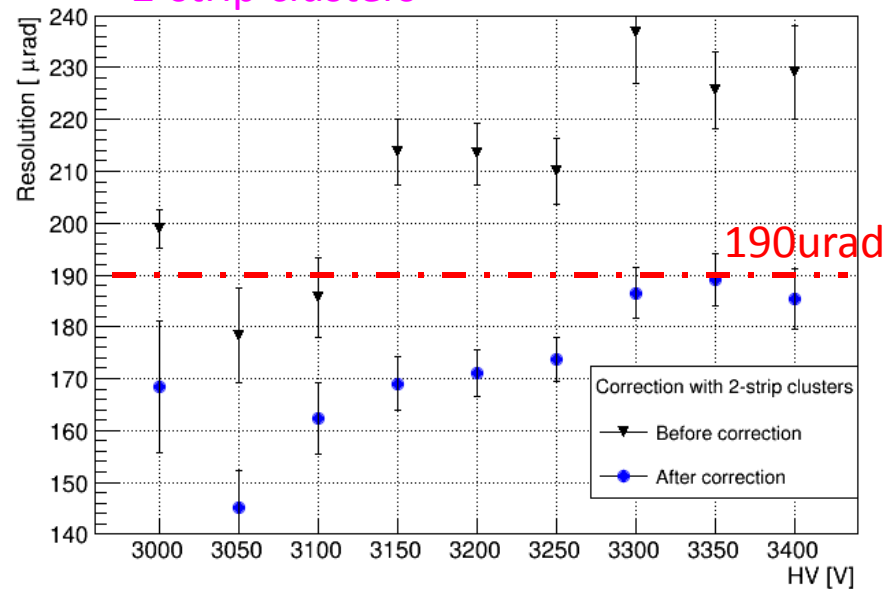
Trackers' resolutions



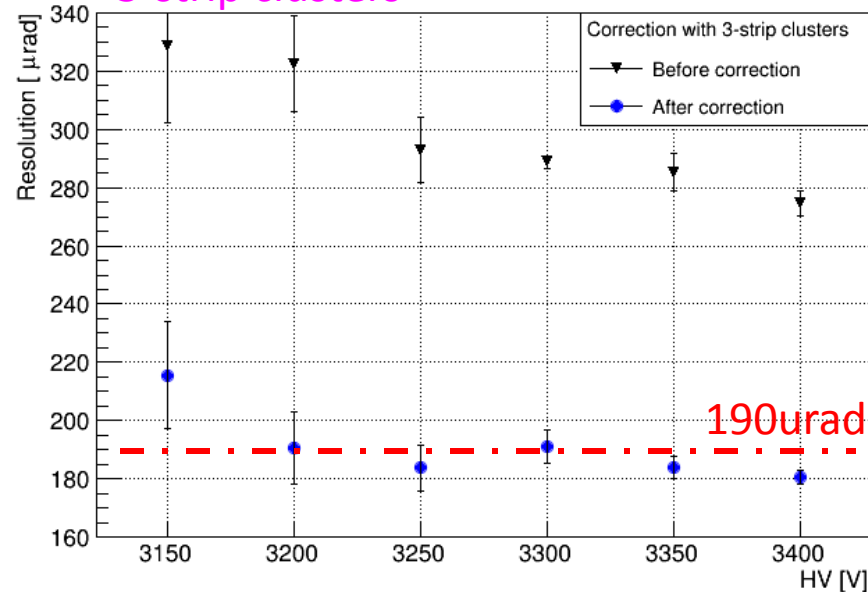
Smear trackers with the found resolutions, check again if the exclusive residual widths match with exp. data, the (max.) difference is less than 10 μm .

FIT zigzag chamber resolution – HV scan

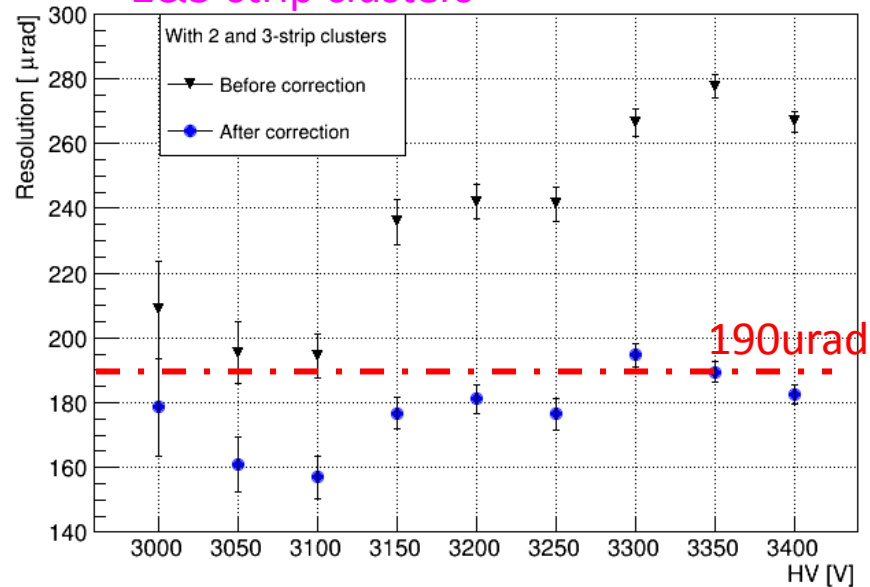
2-strip clusters



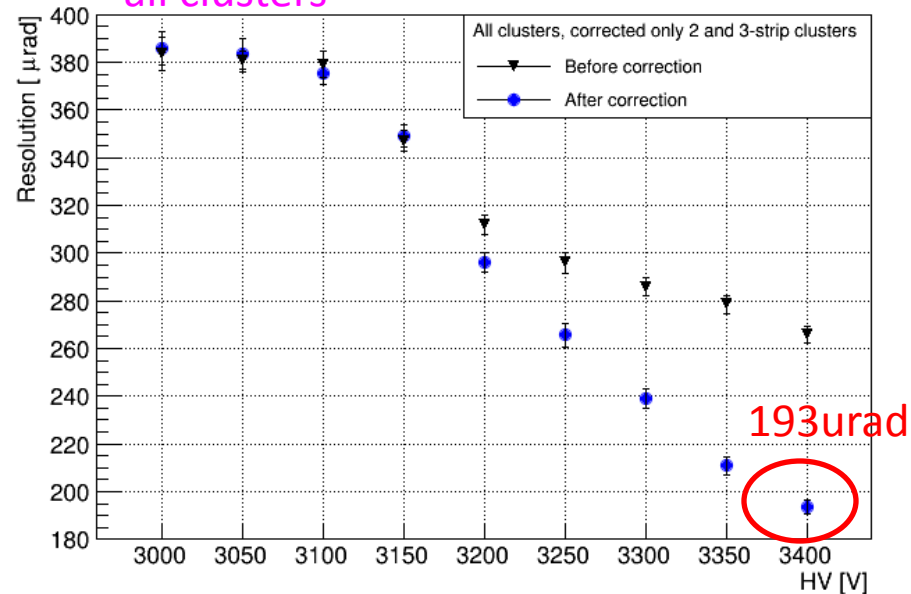
3-strip clusters



2&3-strip clusters

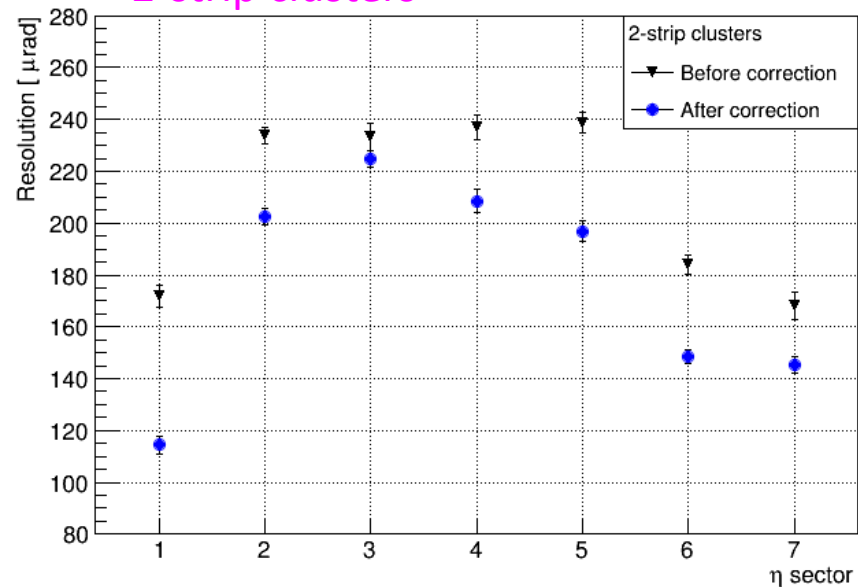


all clusters

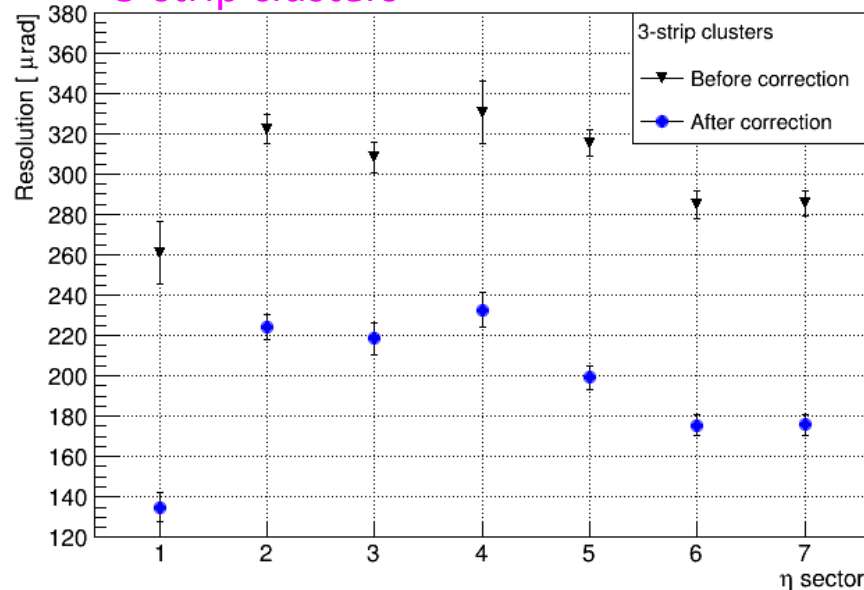


zigzag gem resolution – position scan (3200V), middle sectors

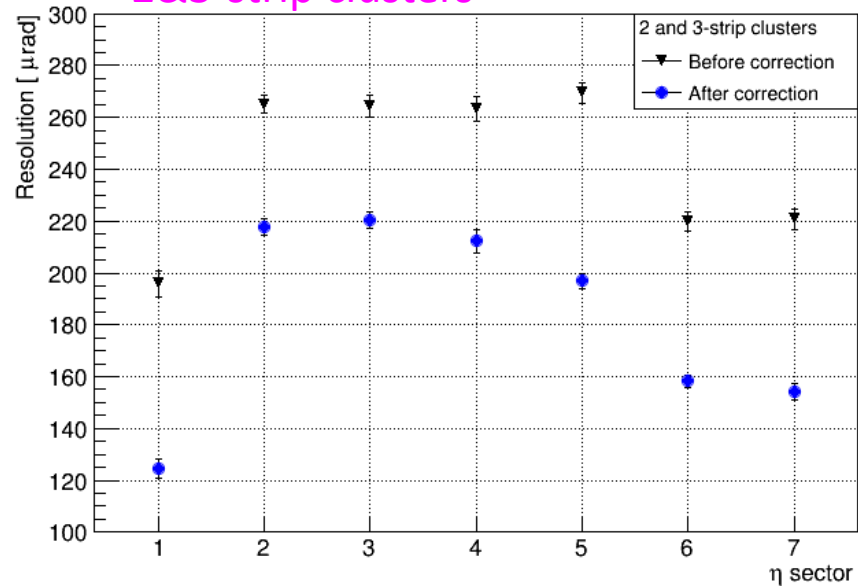
2-strip clusters



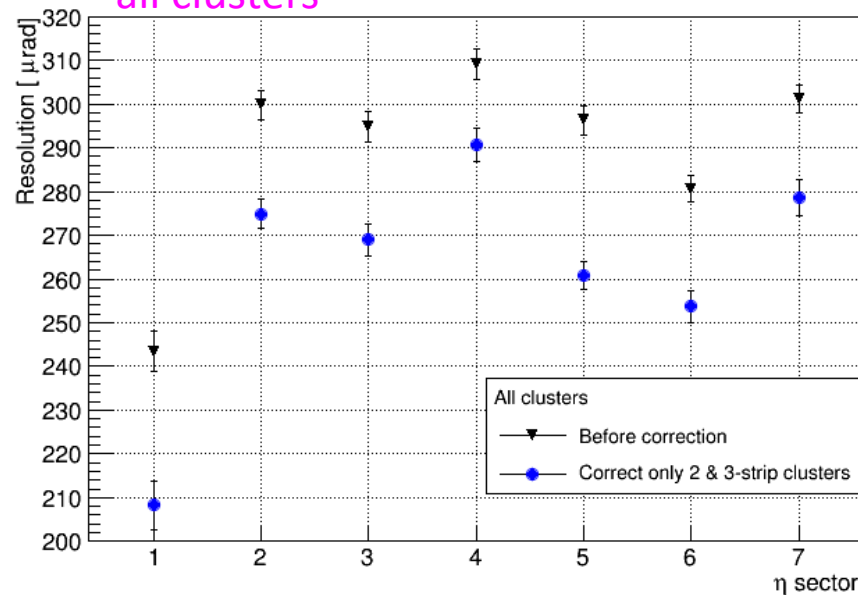
3-strip clusters



2&3-strip clusters

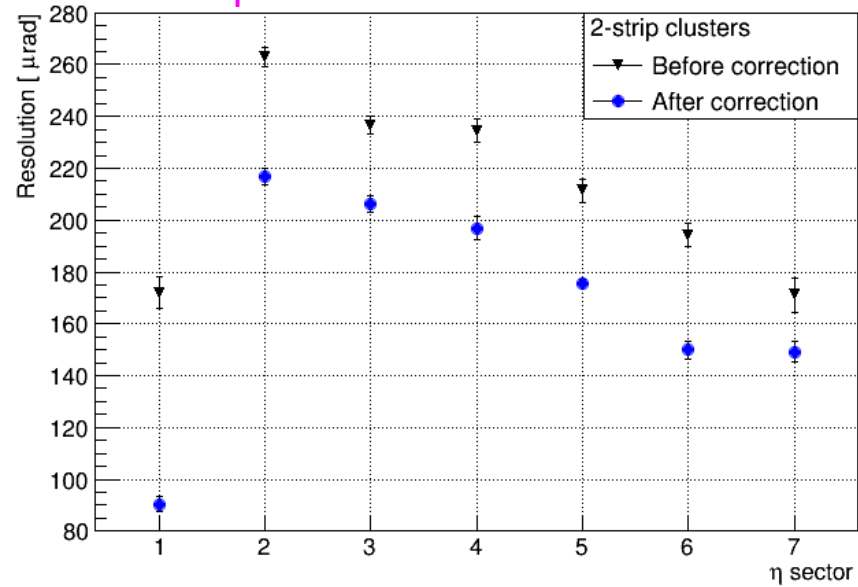


all clusters

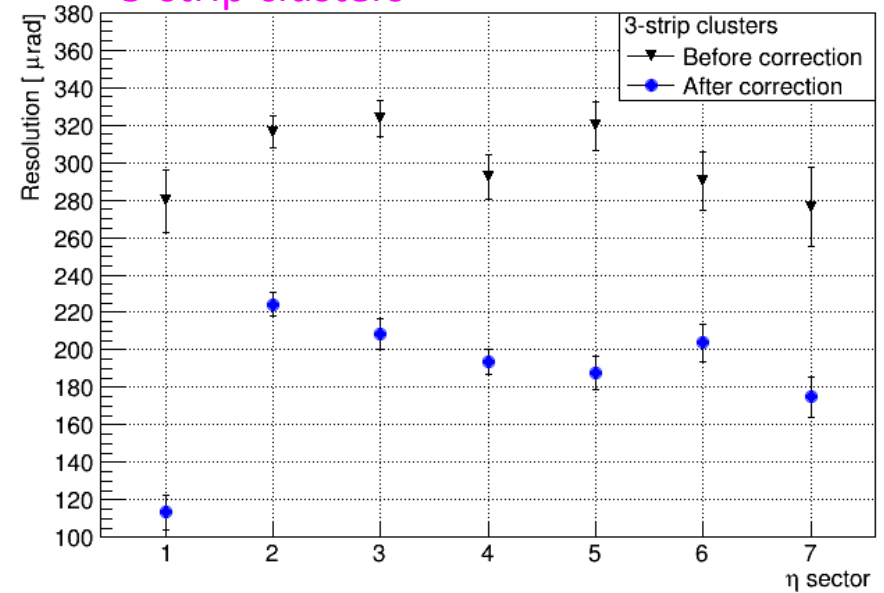


zigzag gem resolution – position scan (3200V), upper sectors

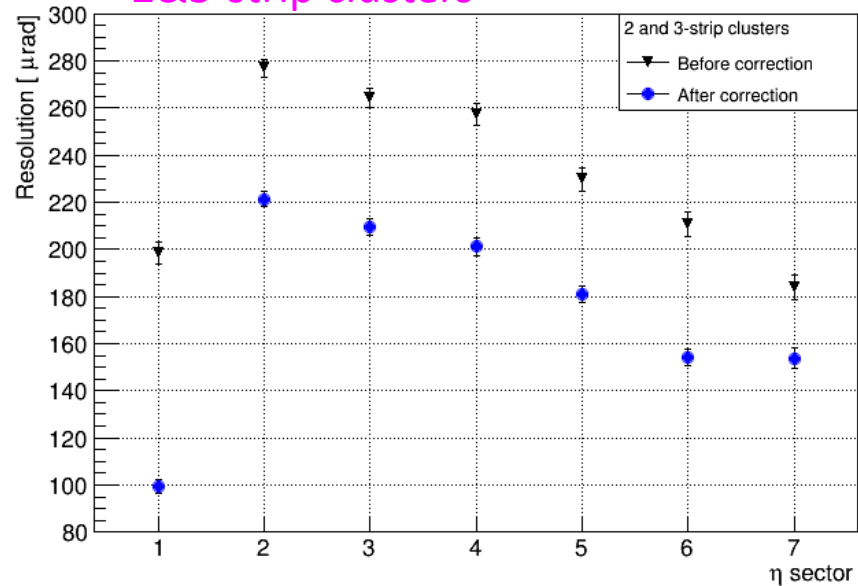
2-strip clusters



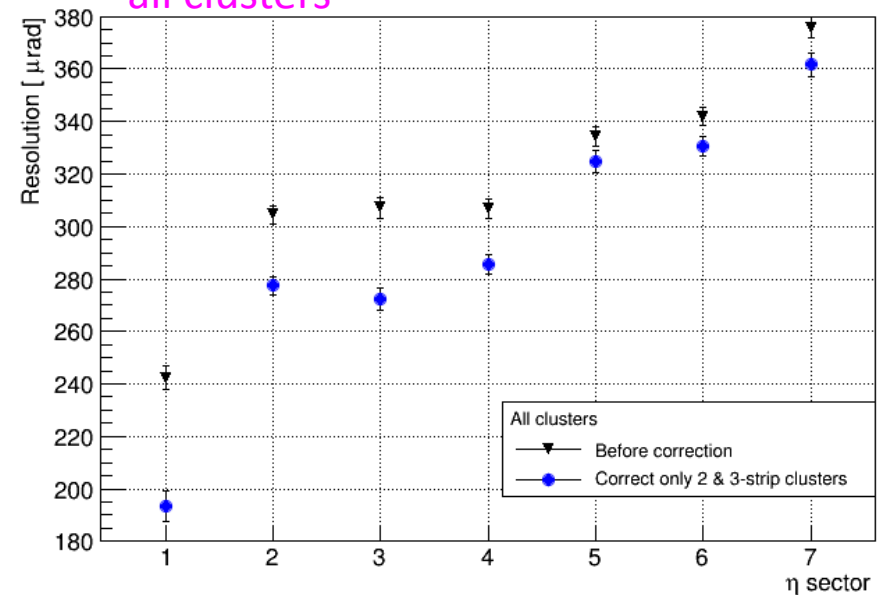
3-strip clusters



2&3-strip clusters



all clusters



Geometric mean method vs. Error estimation method:

1. For trackers. Build tracks with three trackers, compare:

(1) not smear the three trackers, smear the 'probed' tracker from 10 to 140um with a step of 10um.

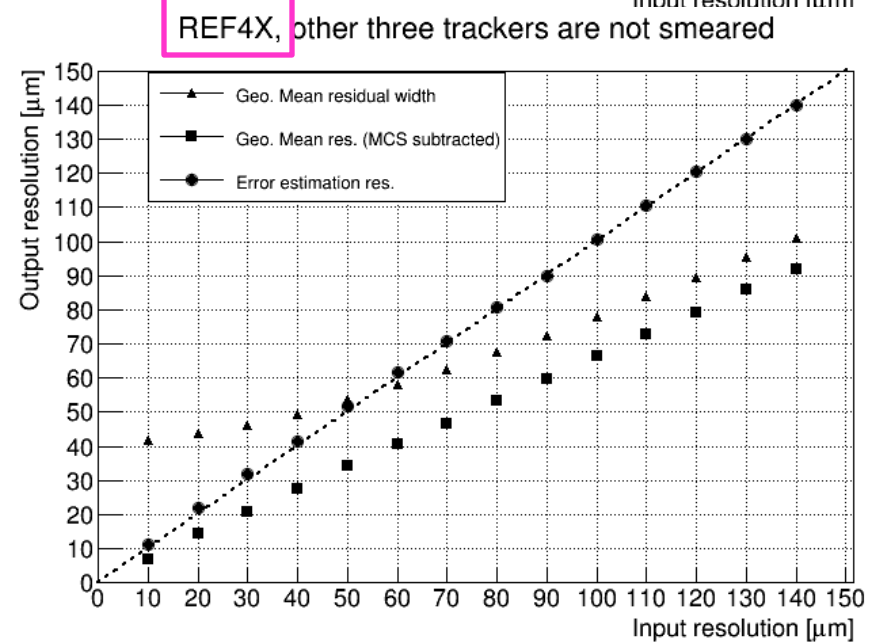
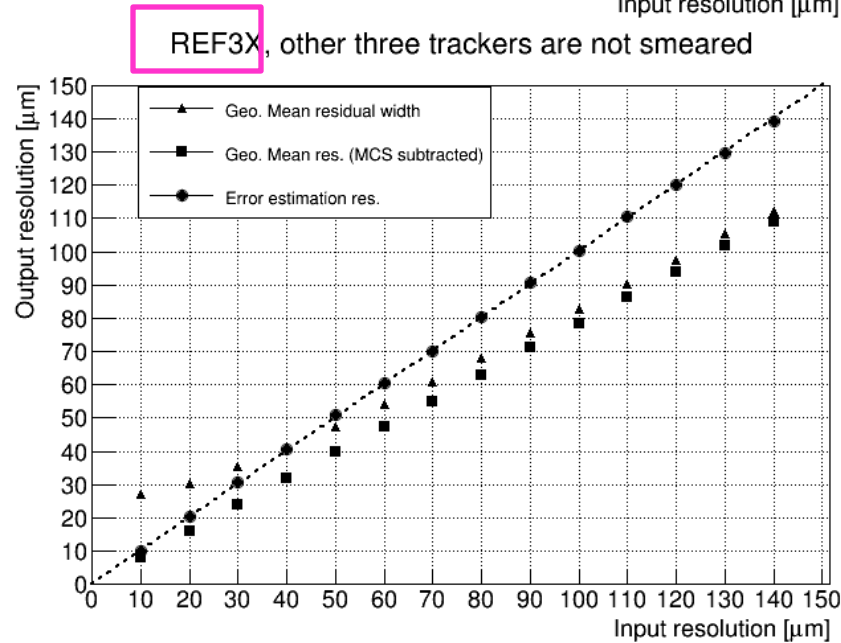
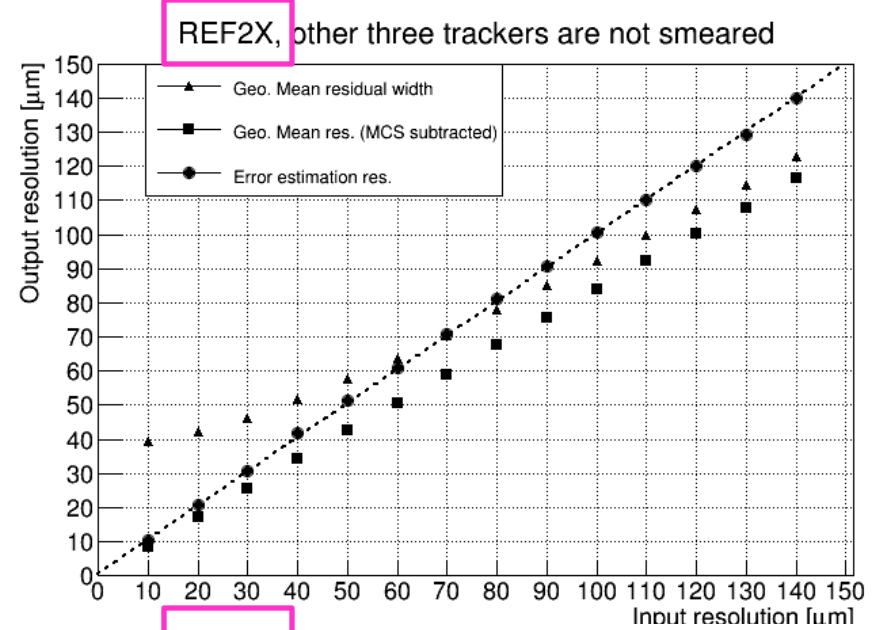
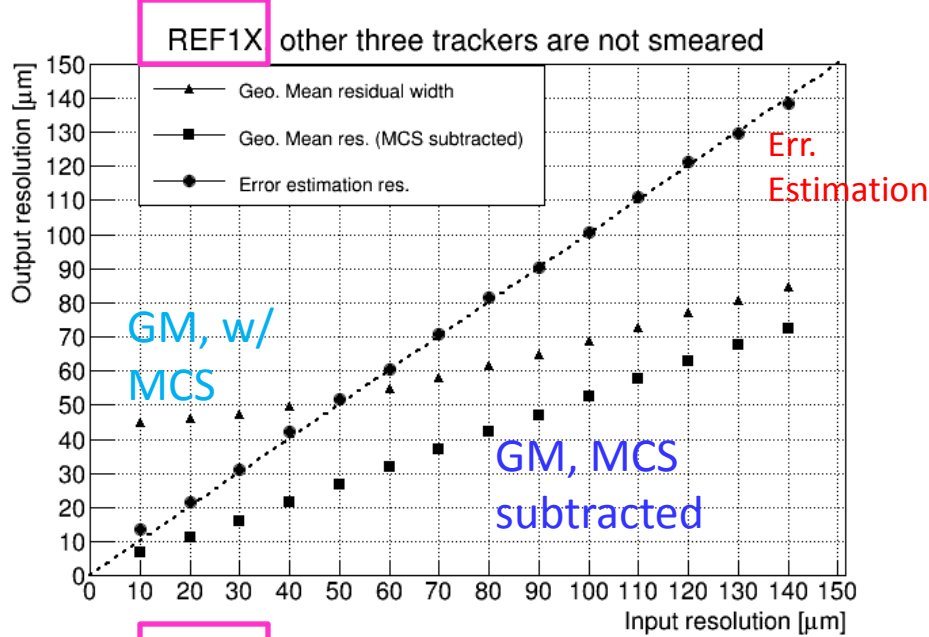
(2) smear the three trackers with resolutions on page 4, smear the 'probed' tracker from 10 to 140 um with a 10um step.

(3) smear the three trackers with a 50um resolution, smear the 'probed' tracker from 10 to 140 um with a 10um step.

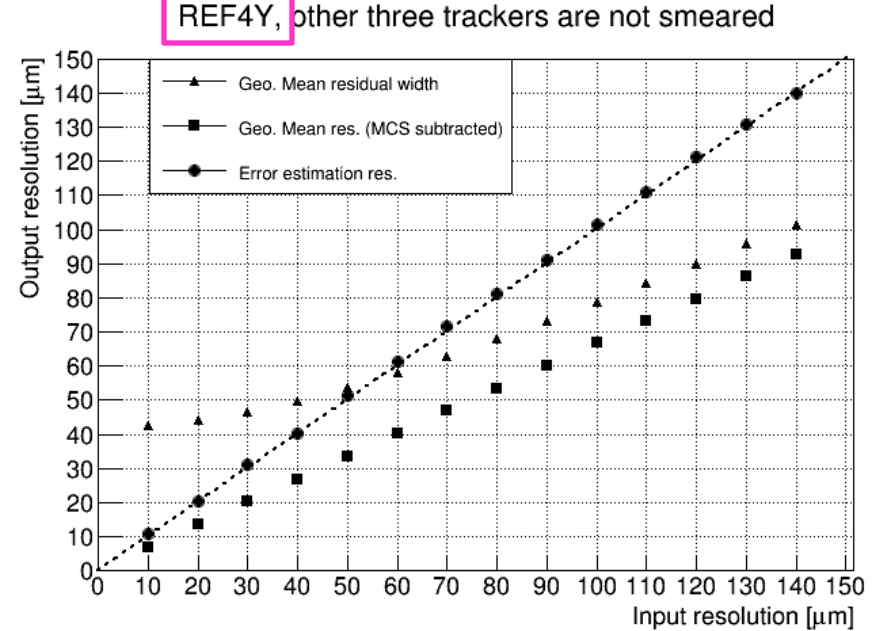
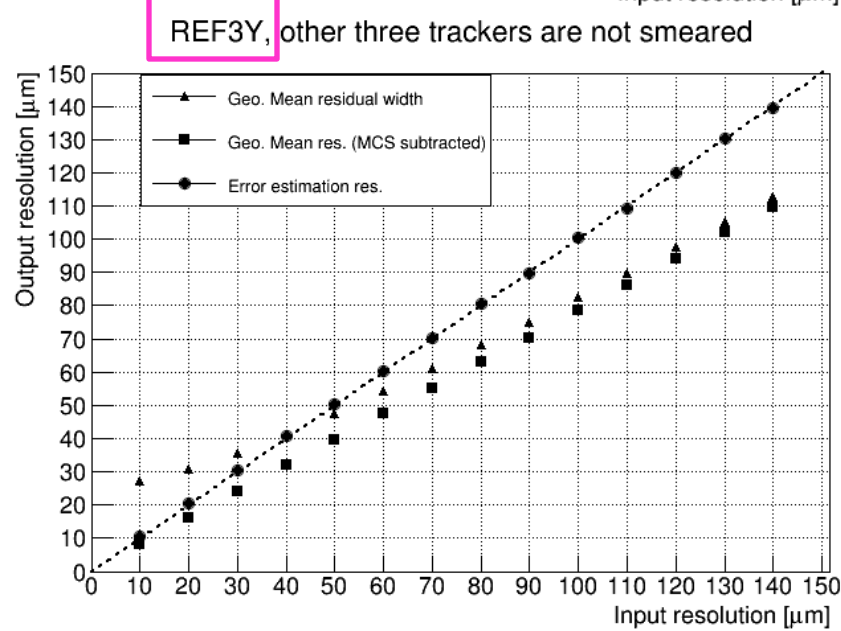
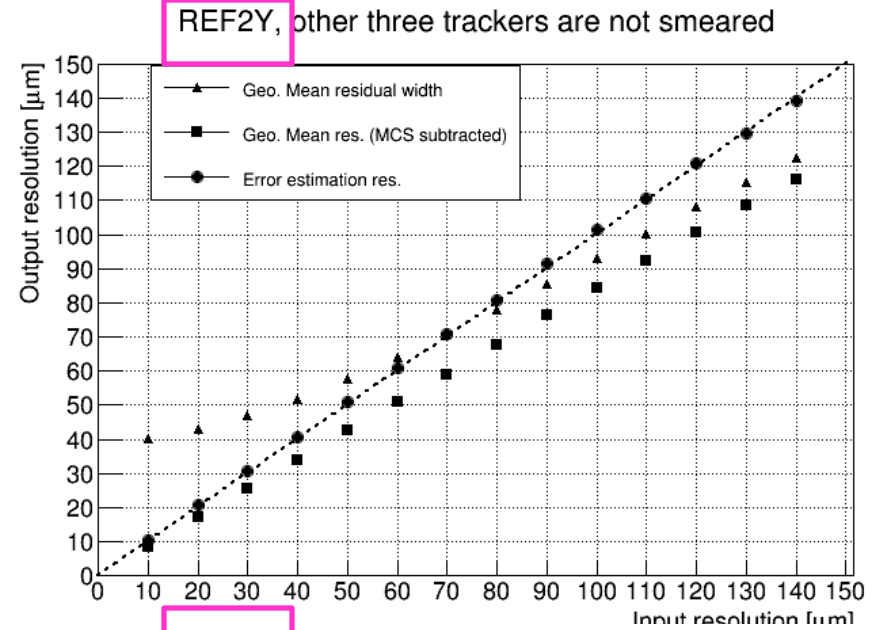
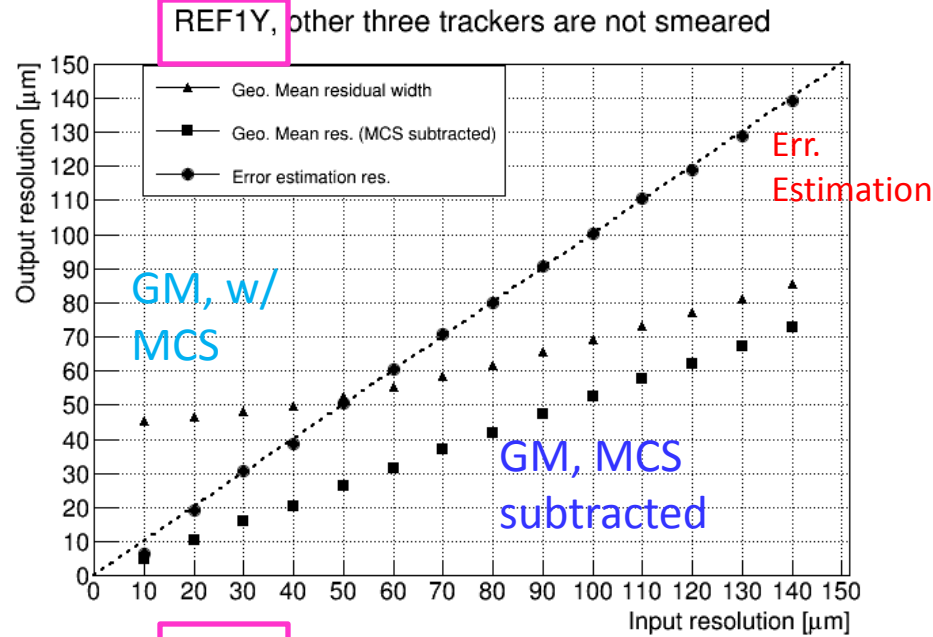
2. For FIT EIC detector. Compare:

(1) smear trackers with resolutions on page 4, smear the FIT EIC chamber from 50um to 290um (30urad to 290urad) with a step of 10um (10urad);

(2) smear trackers with a 50um resolution.

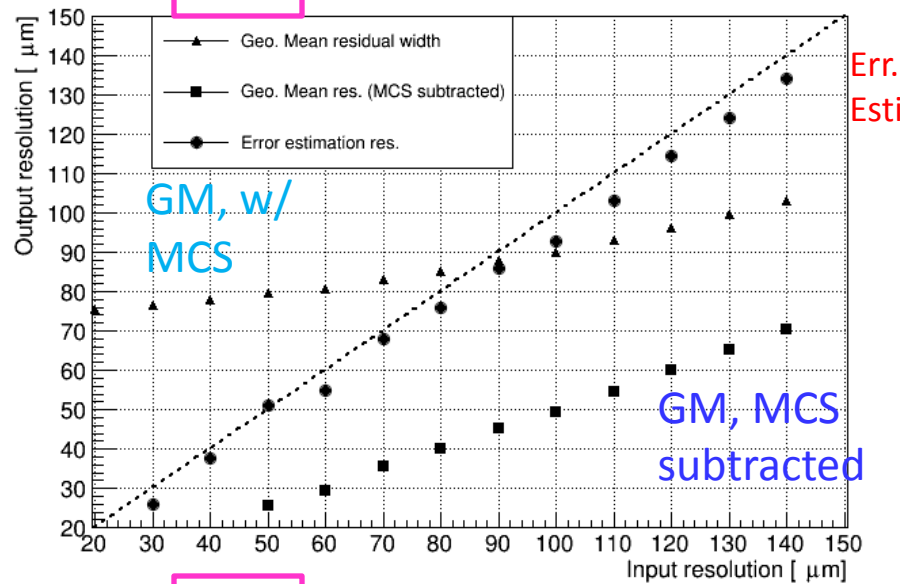


- (1) Use three trackers to test one tracker; the three trackers are not smeared.
- (2) "GM, w/ MCS" include the Multiple Column Scattering effect, it is subtracted in quadrature to get the "GM, MCS subtracted".

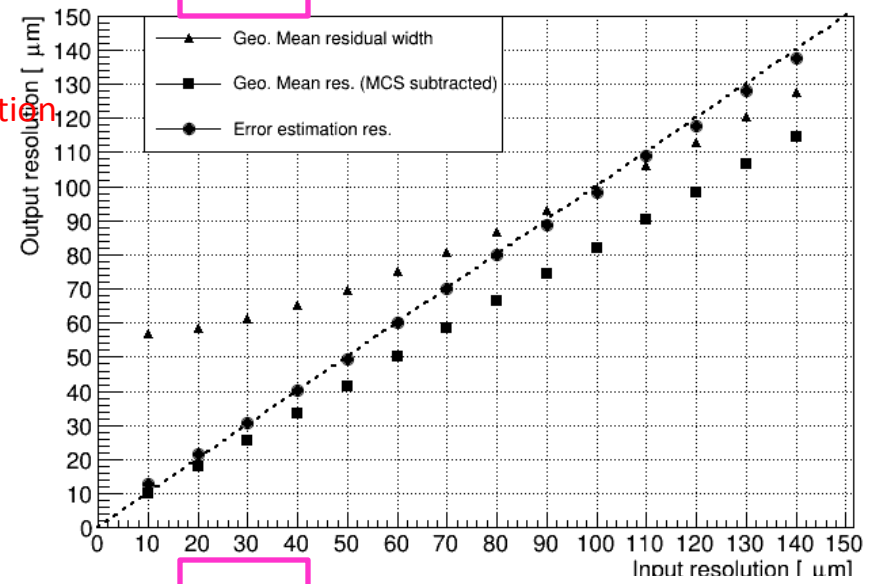


- (1) Use three trackers to test one tracker; the three trackers are not smeared.
- (2) "GM, w/ MCS" include the Multiple Column Scattering effect, it is subtracted in quadrature to get the "GM, MCS subtracted".

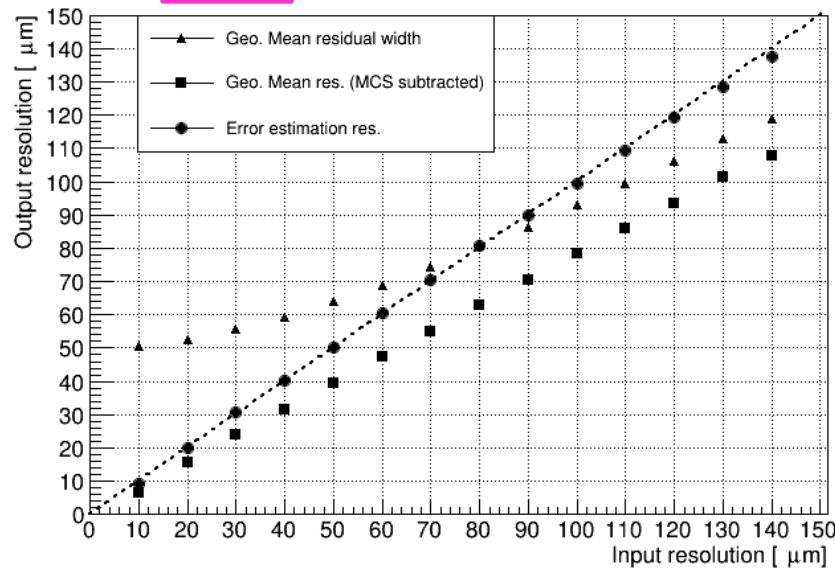
REF1X, other three trackers are smeared



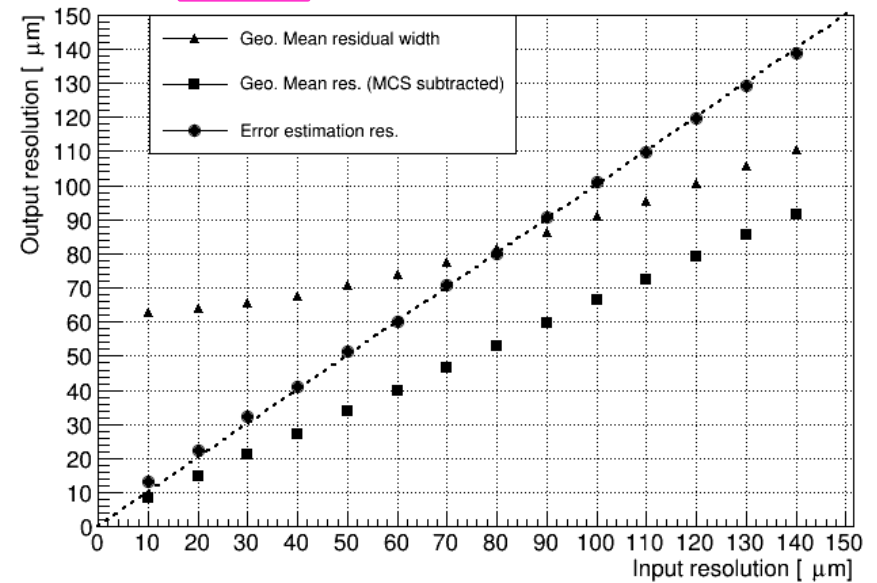
REF2X, other three trackers are smeared



REF3X, other three trackers are smeared

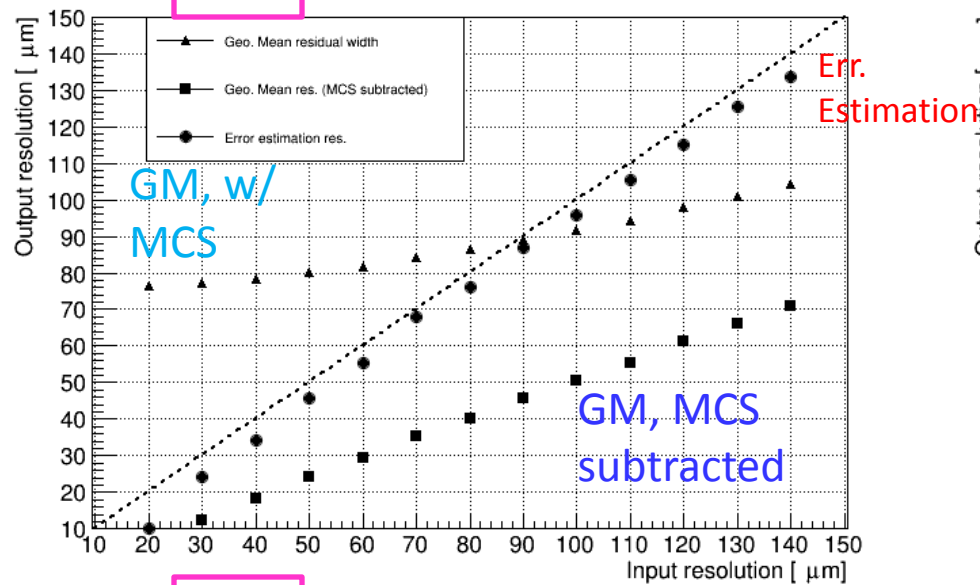


REF4X, other three trackers are smeared

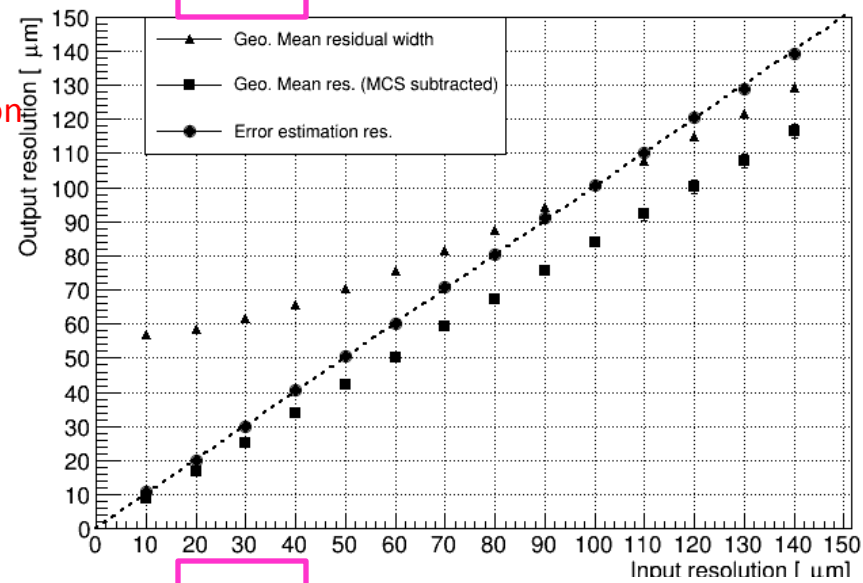


- (1) The three trackers are smeared with the found resolutions.
- (2) "GM, w/ MCS" include the Multiple Columb Scattering effect, it is subtracted in quadrature to get the "GM, MCS subtracted".

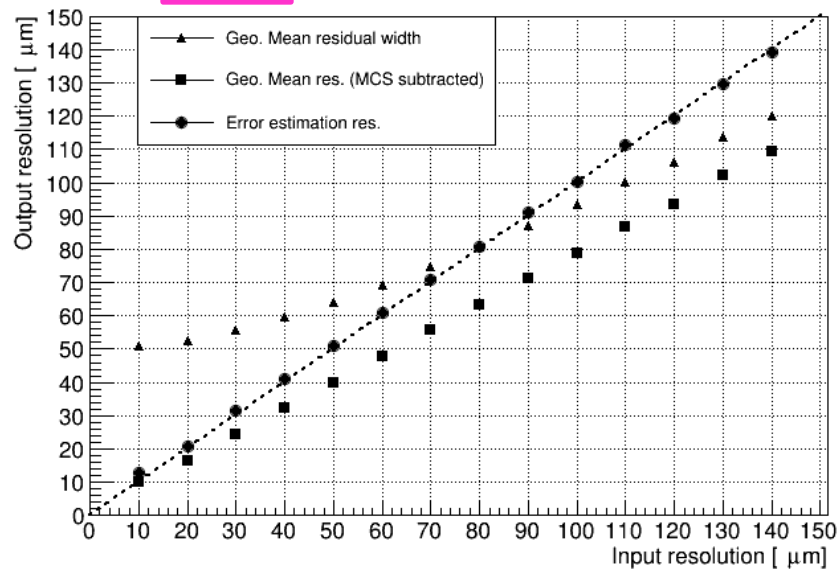
REF1Y, other three trackers are smeared



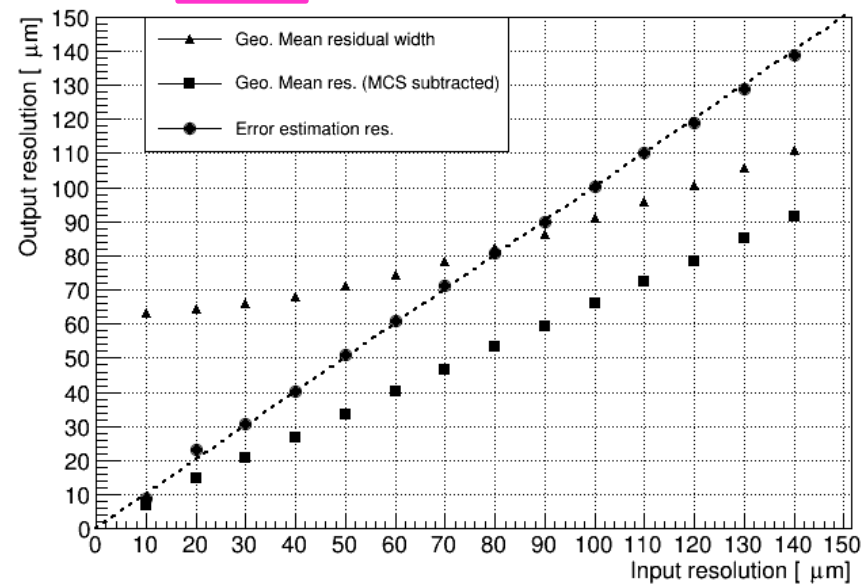
REF2Y, other three trackers are smeared



REF3Y, other three trackers are smeared

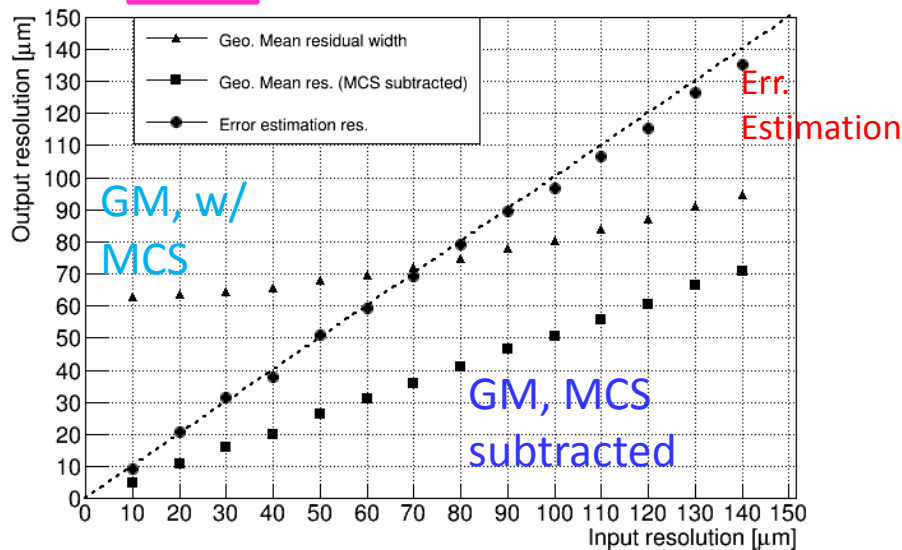


REF4Y, other three trackers are smeared

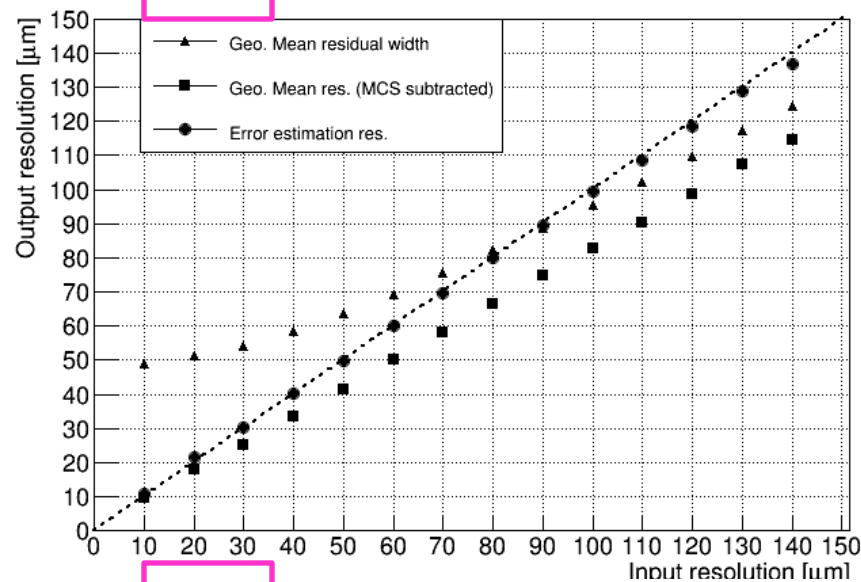


- (1) The three trackers are smeared with the found resolutions.
- (2) "GM, w/ MCS" include the Multiple Columb Scattering effect, it is subtracted in quadrature to get the "GM, MCS subtracted".

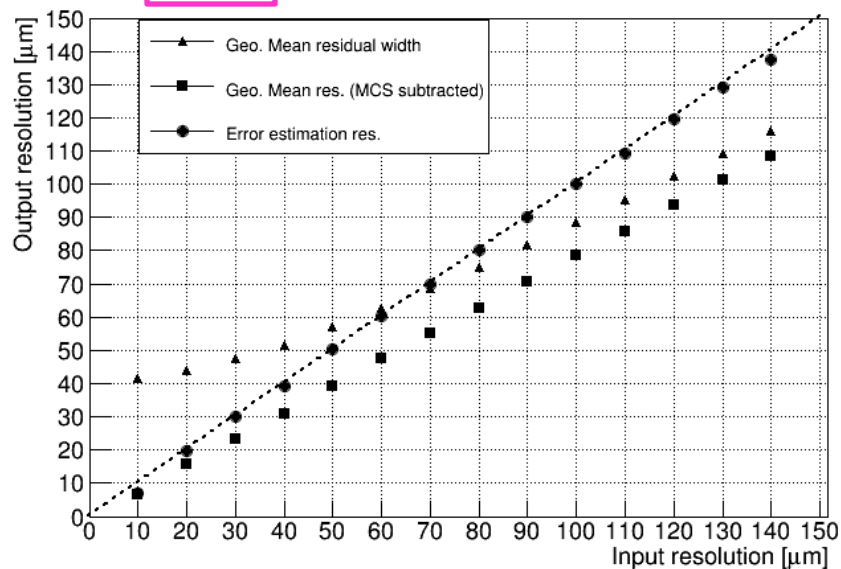
REF1X, other three trackers are smeared by 50 μm



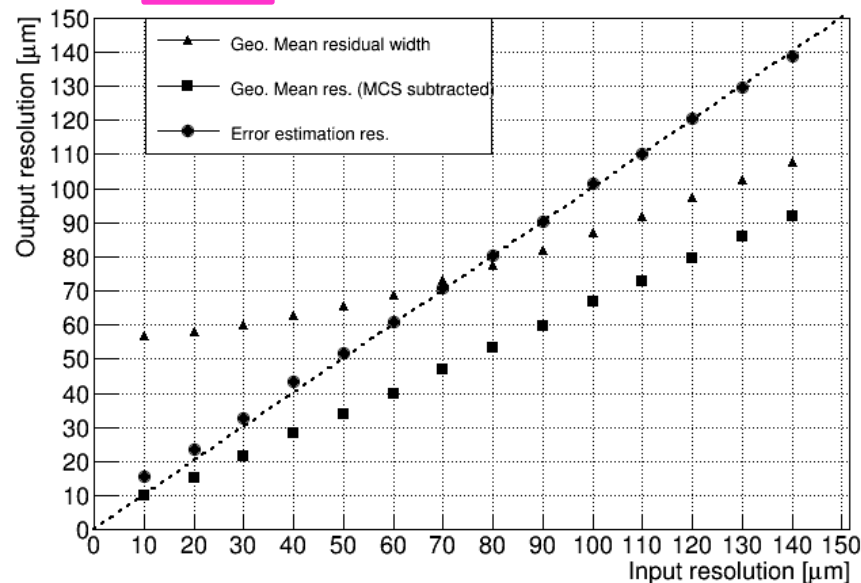
REF2X, other three trackers are smeared by 50 μm



REF3X, other three trackers are smeared by 50 μm

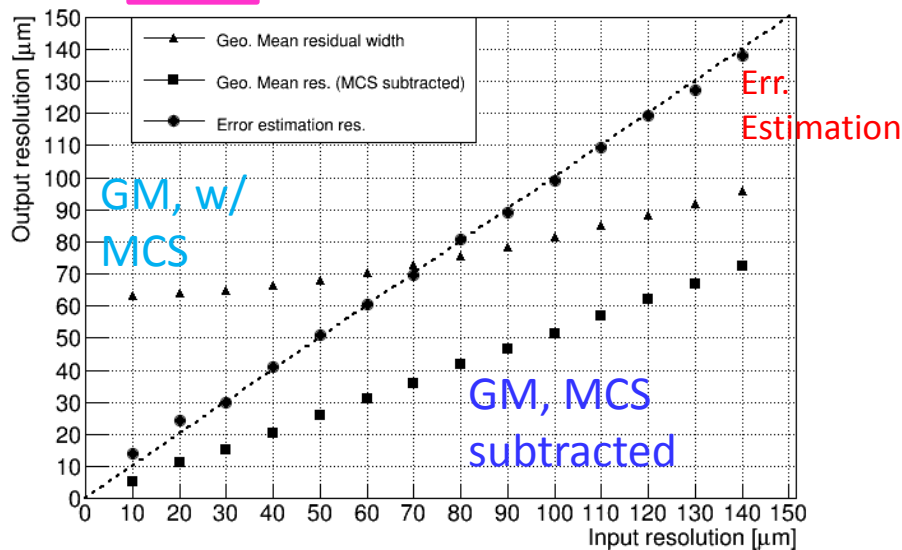


REF4X, other three trackers are smeared by 50 μm

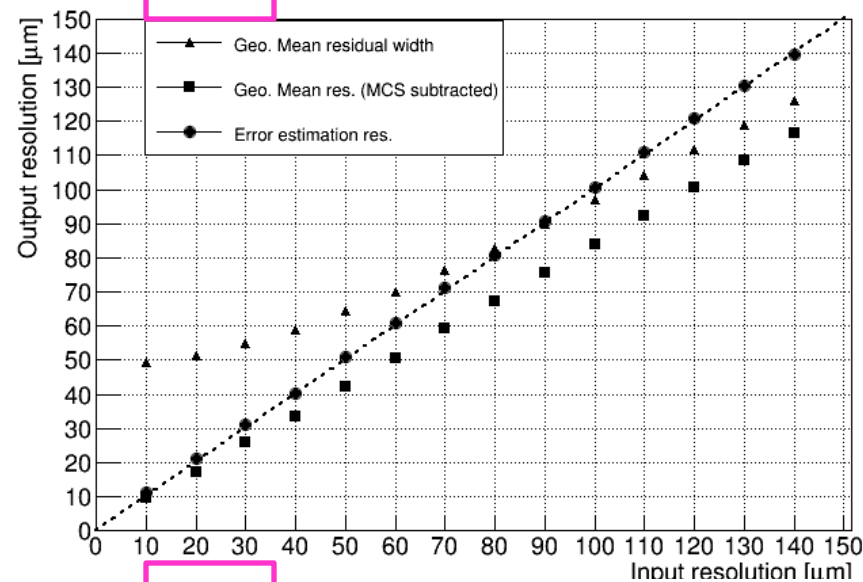


- (1) Use three trackers to test one tracker; the three trackers are smeared with 50 μm res..
- (2) "GM, w/ MCS" include the Multiple Column Scattering effect, it is subtracted in quadrature to get the "GM, MCS subtracted".

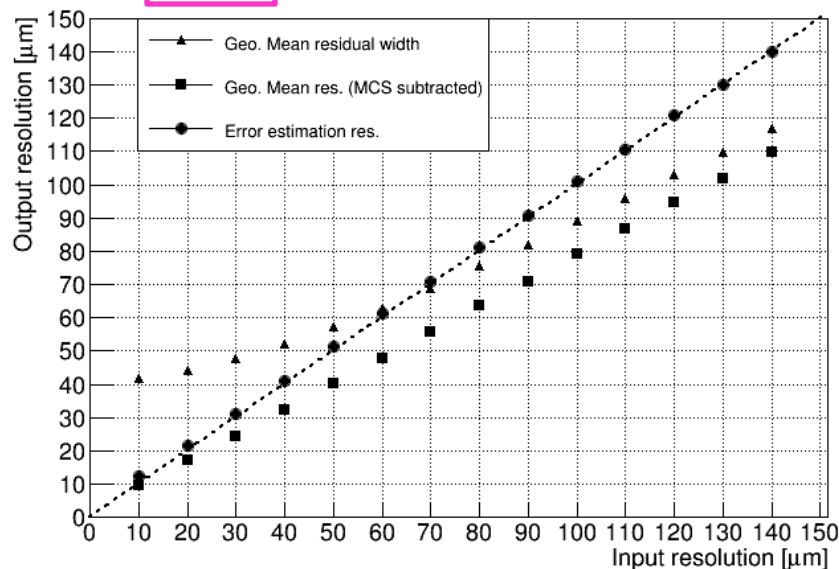
REF1Y, other three trackers are smeared by 50 μm



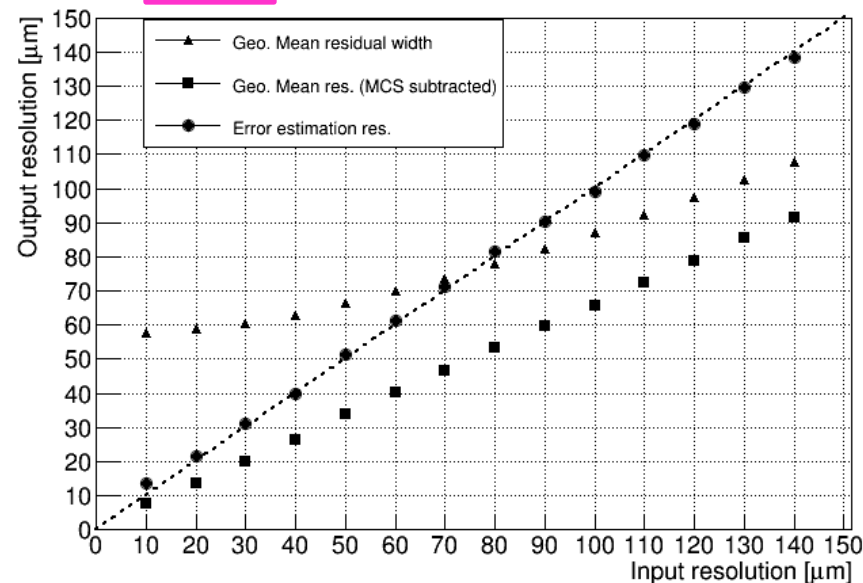
REF2Y, other three trackers are smeared by 50 μm



REF3Y, other three trackers are smeared by 50 μm

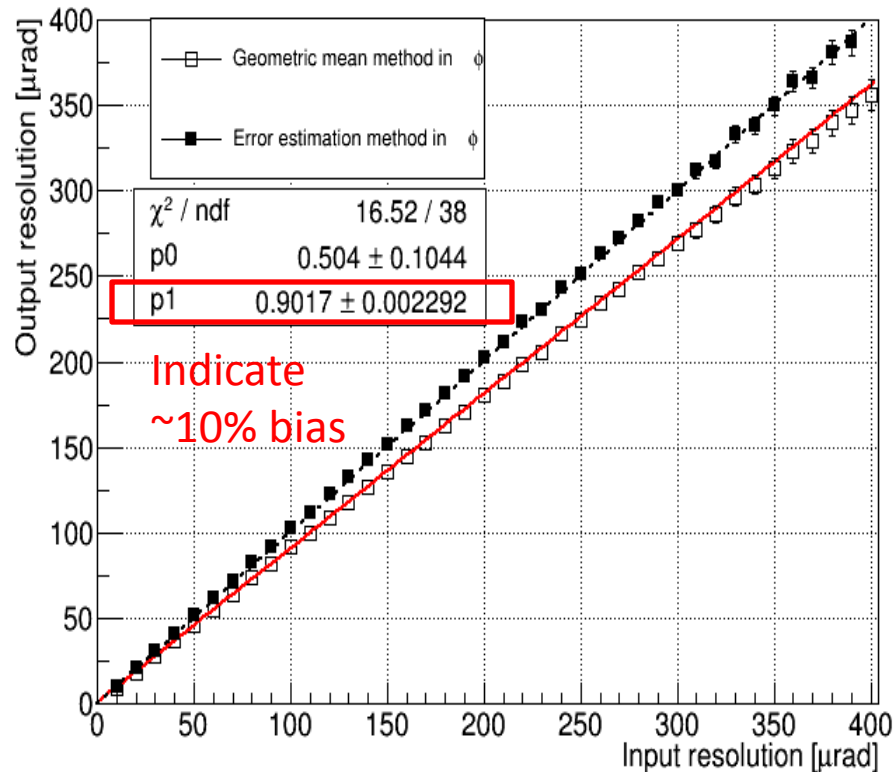


REF4Y, other three trackers are smeared by 50 μm

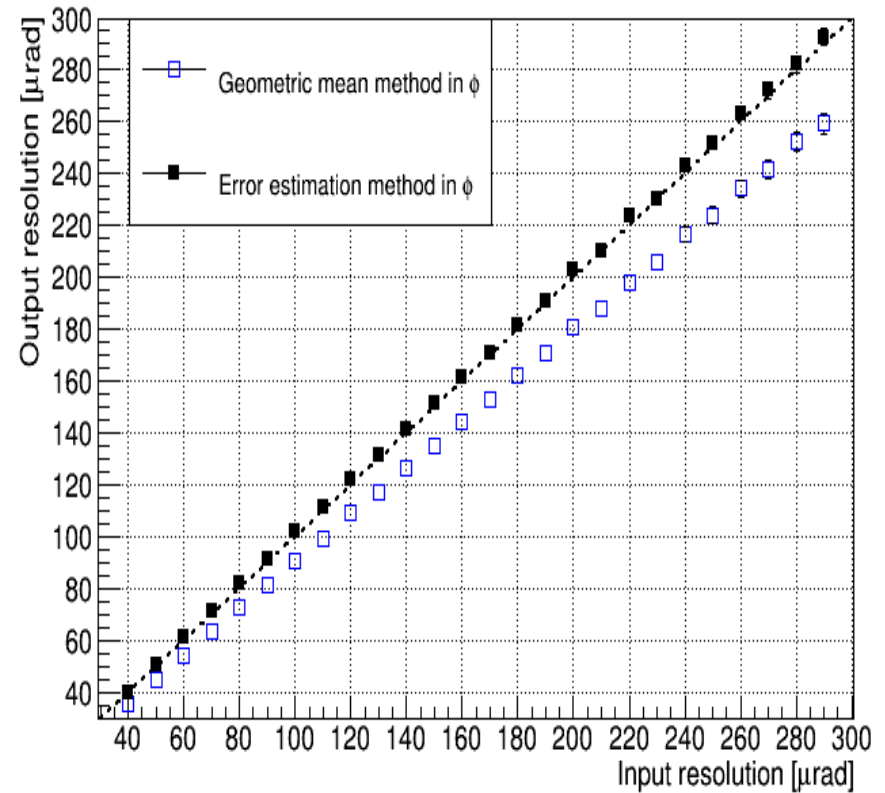


- (1) Use three trackers to test one tracker; the three trackers are smeared with 50 μm res..
- (2) "GM, w/ MCS" include the Multiple Columb Scattering effect, it is subtracted in quadrature to get the "GM, MCS subtracted".

FIT EIC chamber



Trackers are smeared with the found resolutions.



Trackers are smeared with a 50 μm resolution.

Error estimation method vs. Geometric mean method.

Summary:

1. With the Geant4 simulation, track errors can be estimated, multiple scattering effect is clear. Resolutions for trackers and the FIT EIC chamber is precisely estimated. The zigzag GEM resolution is ~ 193 μrad after the non-linear response correction.
2. The geometric mean method gives clear bias, this method is not good to use. No matter what trackers carry same resolutions or not, geo. mean gives (almost) same resolutions.

Thank you!